

A checklist of flesh flies (Diptera, Sarcophagidae) from Assam, India

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ABSTRACT: A comprehensive revised checklist pertaining to taxonomy and bionomics of Sarcophagidae of Assam is prepared. The current study revealed the presence of 23 species, including four endemic and 19 non-endemic from Assam, in comparison to elsewhere in the world.

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KEY WORD: Revised, endemic, forensic, taxonomy, bionomics

INTRODUCTION

The family Sarcophagidae, better known as the flesh flies, consists of 3079 species and 133 genera worldwide (Roskov *et al.*, 2016). In India, Sarcophagidae comprises of 2 sub families (Miltogrammatinae and Sarcophaginae), 17 genus and 126 species, till date. The confirmatory identifying characteristics of this group are the three stripes that run along the dorsal side of the thorax (Chakraborty *et al.*, 2017). The family Sarcophagidae previously known as Sarcophaginae was included in the sub-family of Calliphoridae. It was later separated from Calliphoridae and was included in a separate family namely Sarcophagidae; the taxonomic criteria for separation of Sarcophaginae (now Sarcophagidae) was the absence of setulae on the posterior side of the stem-vein of the wing and four notopleurals on the hind leg (Senior-White, 1940). This paved the way for

the taxonomic revision of this subfamily Sarcophaginae and reclassifying them into the family we now know as Sarcophagidae (Nandi, 1979) and later it was revised to its current taxonomic status by Chakraborty *et al.* (2016, 2017). There is a paucity of information pertaining to the species inventory in the state level for Assam's Sarcophagidae. Although some fragmented attempts were made by some previous authors (Senior- White, 1940), (Nandi, 1977a, b, 1978, 1979a, b, c), which described only 15 species from this region. Chakraborty (2019) highlights the pivotal role of meat flies, in ecosystems. Meat flies are crucial decomposers, environmental indicators, and research subjects, contributing to ecosystem balance, maintaining nutrient levels, and have applications in forensics and medicine. A comprehensive revised checklist pertaining to taxonomy and bionomics of Sarcophagidae of Assam is discussed.

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MATERIALS AND METHODS

Taxonomic nomenclature used for the checklist follows (Evenhuis, 2023). The Indian distribution and elsewhere are also given, along with the synonyms of the species. The study is based on the available literature, rather than on extensive new taxonomic work. Most of the names of the species presented here are in accordance with the most recent scheme of classification following (Evenhuis, 2023). Dipterans stored in the repository of National Zoological Collection in the Zoological Survey of India, H.Q. Kolkata, were studied and utilized for the preparation of the checklist. The national zoological collection and general Diptera collection was also consulted from the central entomological labs of Zoological Survey of India, H.Q. of registration numbers 5333/H6 to 8301/H6.

Taxonomic literatures were reviewed for extracting out Indian species of the medico-legally important dipterans from internet sources and other relevant literature searches, like Catalogue of Life (updated on September, 2023), *Systema Dipterorum* (updated on September, 2023) (Evenhuis, 2023), *Oriental catalog* (Mercedes and Hardy, 1977), *Fauna of British India* (White, 1940) and *Catalog of Diptera from Australasian and Oceania regions* (Evenhuis, 2016), *Zoo records series* (2016 to 2023) and *State fauna series* and Open internet search for papers on the family Sarcophagidae (1940 to 2023).

Numerical taxonomy was done with the help of M.S. excel where the various per cent of the species abundance was given in Assam. The per cent of the various bionomics is also shown here. This was achieved by dividing on criteria basis and utilizing graphs to visualize data (Sokal, 1963). At first, found out the sub-families per cent, endemic species criteria are those species which has only been recorded from a certain specified historic geographic range. Dividing the no. of individuals from sub-families *Miltogrammatinae* (Enderlein 1928) and *Sarcophaginae* (Townsend, 1917) by total no. of species. The same way the bionomics of the various species is also done. The list is arranged till subgenus and genus level and alphabetically thereafter, to make the search easier for a given

taxon. Main references to the original distribution and host preference are listed. The acronyms used for collections follow the standard of the *Systema Dipterorum* (Evenhuis, 2023).

RESULTS AND DISCUSSION

There are 23 species in total from Assam. Among them 20 (86.95%) are from the sub-family *Miltogrammatinae* (Enderlein 1928) and 3 (13.04%) are from Sarcophaginae (Townsend, 1917). The species bionomics study shows *Sarcophaga (Sarcorohdendorfia) antilope* (Bottcher, 1913) (4.34%) seems to be parasitoid of Lepidoptera. The comprehensive analysis of the flesh fly (Diptera, Sarcophagidae) species found in Assam, India provides valuable insights into the diversity and ecological roles of this important group of flies in the region. The key findings indicate that the Sarcophagid fauna of Assam is dominated by species from the subfamily Miltogrammatinae, accounting for 86.95 per cent of the 23 total species identified (Table 1, 2).

The diverse bionomics exhibited by these flesh flies highlights their adaptability to a range of ecological niches. The preference of certain species for bushes, nests, symbiotic relationships, carrion, and feces suggests they play important roles in nutrient cycling, decomposition, and potentially even as vectors of pathogens. This information is crucial for understanding the broader ecosystem functions and public health implications of Sarcophagids in Assam. Further research is needed to fully elucidate the ecological interactions, seasonal dynamics, and potential forensic applications of these flesh fly species. Expanding the survey efforts to other regions of Assam and northeastern India could also uncover additional undocumented species, providing a more comprehensive picture of Sarcophagid diversity in the state.

***Miltogramma angustifrons* and *Phylloteles hyalipennis*:** These two Miltogrammatinae flies are found in the Doom Dooma and Cachar/Rashan regions of Assam, respectively, and are not recorded elsewhere in India. They breed in the nests of various Hymenoptera insects like Vespidae, Sphecidae, Apidae, Eumenidae and Trypoxylionidae.

Table 1. Check list of Sarcophagidae species, bionomics and distribution in Assam

No.	Species	Sub Family	Bionomics	Distribution	Distribution in India
1	<i>Miltogramma angustifrons</i> (Townsend, 1933)	Miltogrammatinae Enderlein 1928	Breed in the nests of Vespidae, Sphecidae, Apidae, Eumenidae and Trypoxylionidae. Some of the adult flies are attracted to nectar and damaged fruits of different kinds of trees	Doom Dooma	Not recorded elsewhere in India.
2	<i>Phylloteles hyalipennis</i> (Baranov, 1934)	Miltogrammatinae Enderlein 1929	Some larvae are predators or guests in the nests of Hymenoptera, Orthoptera and Isoptera.	Cachar, Rashan	Not recorded elsewhere in India.
3	<i>Senotainia navigatrix</i> (Meijere, 1910)	Miltogrammatinae Enderlein 1930	Sphecidae /Apidae nest	Silchar	Bihar (Pusa), Kerala (Midigare), Karnataka (Trivandrum), Tamil Nadu (Cinchona).
4	<i>Sarcophaga (Bercaea) africa</i> (Wiedemann, 1824)	Sarcophaginae Townsend, 1917	Bait of raw fish	Assam	Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Uttar Pradesh, WestBengal, Bihar (Several localities).
5	<i>Sarcophaga (Fengia) ostindicae</i> (Senior-White, 1924)	Sarcophaginae Townsend, 1917	Bushes	Assam	Mizoram: Aizawal P.U. College campus, 1,100m, Aizwal, Bonkon, 1050m, Kolasib, 800m and Uttar Pradesh (Dehradun)
6	<i>Sarcophaga (Harpagophalla) kempi</i> (Senior-White, 1924)	Sarcophaginae Townsend, 1917	Dead sphingid larva	Barpathar, Dibrugarh, Jorhat	Arunachal Pradesh (Tipi), Bihar (Deoghar, Giridih, Mahaudanga, Pusa), Himachal Pradesh (Dharmasala), Sikkim (Gangtok), Kerala (Trivancore), Manipur (D.M. College campus), Meghalaya (Shilong, Singimari), Mizoram Aizwal, Kolasib, Lunglei), Tripura (Kanchanpur, Sipahijala), Nagaland (Dimapur) and West Bengal (Arabariforest, Bhatpur, Calcutta, Chandrapur forest, Gorumara forest, Kenduah, Ketka, Susunia forest), Karnataka, Madhya Pradesh, Uttar Pradesh
7	<i>Sarcophaga (Iranihindia) futilis</i> (Senior-White, 1924)	Sarcophaginae Townsend, 1917	In bushes, grasses and flowering plants	Silchar	Arunachal Pradesh (Mangalagiri), Bihar (Chapra, Pusa, Chota Nagpur, Deoghar, Dumraon, Giridhi water falls, Hazaribagh, Patna, Raja Rappa water falls, Rajgir),

					Jharkhand (Ranchi, Titalgarh), Gujrat (Ahmedabad, Bet Dwarka, Dwarka, Gir sanctuary), Karnataka (Bannerghata National park, Banglore, Kellar, Mysore), Kerala (Calicut, Wilingdonisl.), Maharashtra (Lonavale, Nagpur), Madhya Pradesh (Artham, Jonk river), Nagaland (Dimapur), Mizoram (Aizwal, Bonkon), Orissa (Ashanput, Balugaon, Hirakund), Tamil Nadu (Coimbatore, Chennai, Parvatipuram), Tripura (Matabari, Pratia forest), Uttar Pradesh (Dehradun), West Bengal (Bhatpur, Bishnupur, Calcutta, Dulmi West, Kachujur, Sahebbundh, Sasankali, Purulia), Andhra Pradesh, Karnataka, Orissa; Barkuda isl., Tripura
8	<i>Sarcophaga (Iranihindia) indica</i> Nandi, 1979	Sarcophaginae Townsend, 1917	Bushes in forest area	Assam	Andra Pradesh, Kerala, Karnataka, Maharashtra, Tamil Nadu WestBengal (Birbhum; Panchubaga, Midnapore; Salboni), Bihar (Hazaribagh National Park: 300m, Palamau National Park: 320m, Madhudanga, Netarhat).
9	<i>Sarcophaga (Iranihindia) martellata</i> (Senior-White, 1924)	Sarcophaginae Townsend, 1917	Spoiled beef as bait	Silchar	Andhra Pradesh, Arunachal Pradesh (Manalagiri), Bihar (Chota Nagpur, Deoghar, Dumraon, Giridhi water falls, Hazaribagh, Patna, Raja Rappa water falls, Rajgir), Jharkhand (Titalgarh), Gujrat (Ahmedabad, Bet Dwarka, Dwarka, Gir Sanctuary), Karnataka (Bannerghata National Park, Bangalore, Kellar, Mysore), Kerala (Calicut, Willingdon isl.), Maharashtra (Lonavale, Nagpur), Madhya Pradesh (Artham, Jonk river), Nagaland (Dimapur), Mizoram (Aizwal, Bonkon), Orissa (Ashanput, Balugaon, Hirakund), Tamil Nadu (Coimbatore, Chennai, Parvatipuram), Tripura

					(Matabari, Pratia forest), Uttar Pradesh (Dehradun), West Bengal (Bhatpur, Bishnupur, Calcutta, Dulmi West, Kachujur, Sahebbundh, Sasankali
10	<i>Sarcophaga</i> (<i>Liopygia</i>) <i>ruficornis</i> (Fabricius, 1794)	Sarcophaginae Townsend, 1917	Baits of decayed carrion, rabbit, fish, liver, and chicken. Cause myiasis in Dogs	Assam	Andhra Pradesh, Bihar, Delhi, Meghalaya, Mizoram, Goa, Gujrat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and Union territories of Andaman and Nicobar Isl. Dadra and Nagar Haveli, Delhi, Lakshdweep and Pondicherry
11	<i>Sarcophaga</i> (<i>Liosarcophaga</i>) <i>brevicornis</i> Ho, 1934	Sarcophaginae Townsend, 1917	Pig carcasses	Assam	Andhra Pradesh, Arunachal Pradesh, Bihar, Gujrat, Himachal Pradesh, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Rajasthan, Tripura and West Bengal.
12	<i>Sarcophaga</i> (<i>Liosarcophaga</i>) <i>dux</i> (Thomson, 1869)	Sarcophaginae Townsend, 1917	Carcass of Chicken, Toad, Fish, Rat, Lizard	Assam	Andhra Pradesh, Arunachal Pradesh, Bihar, Delhi, Jammu and Kashmir, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal and the union territories of Andaman and Nicobar Isl. and Lakshadweep.
13	<i>Sarcophaga</i> (<i>Liosarcophaga</i>) <i>sarupi</i> (Nandi, 1979)	Sarcophaginae Townsend, 1917	Vertebrate carcasses	Champhai Assam rifle area	Uttar Pradesh; Nainital, 1230m, Uttar Pradesh; Kaushani, 1890m, Mizoram; Champhai, P .W.D. Campus, 1600m, 1615m and Meghalaya (Barapani)
14	<i>Sarcophaga</i> (<i>Liosarcophaga</i>) <i>scopariiformis</i> (Senior-White, 1927)	Sarcophaginae Townsend, 1917	Dead bodies and carcasses	Dibrugarh, Nowgong	Karnataka (Chikmagalore), Kerala (Walayarforest), Manipur (Imphal), Mizoram (Aizwal), Nagaland (Dimapur), Tripura (Kanchanpur, Matabari),

					Tamil Nadu (Tranquebar) and West Bengal (Daimond harbour, Gour, Rudranagar, Sankrail.
15	<i>Sarcophaga (Pandelleisca) assamensis</i> (Nandi & Ray, 1982)	Sarcophaginae Townsend, 1917	Human excrement	Jorhat	Manipur; D.M.College campus.
16	<i>Sarcophaga (Pandelleisca) bainbriggei</i> (Senior-White, 1925)	Sarcophaginae Townsend, 1917	Human excrement	Silchar	Bihar (Deoghar, Pusa), Himachal Pradesh (Solan), Kerala (Kurumbagram), Orissa (Balugaon, Nandankanan, Taptapani), Tripura (Trishna), Tamil Nadu (Coimbatore, Chennai, Tranguebar) and West Bengal (Baharampur, Bishnupur, Calcutta, Gour Suri)
17	<i>Sarcophaga (Parasarcophaga) albiceps</i> (Meigen, 1826)	Sarcophaginae Townsend, 1917	Decaying larvipost of Mutton	Assam	Andhra pradesh, Arunachal Pradesh, Bihar, Chandigarh, Delhi, Goa, Gujrat, Hararyana, Himachal Pradesh; Kullu; 6,000ft, Mizoram, Nagaland, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Andaman and Nicobar, Delhi, Karnataka, Kerala, Madhya Pradesh, Manipur, Maharashtra, Orissa, Panjab, Chandighar, Daman Diu, Pondicherry.
18	<i>Sarcophaga (Parasarcophaga) misera</i> (Walker, 1849)	Sarcophaginae Townsend, 1917	Decayed carrion-baits, human faeces, carcasses and dead fish	Assam	Andhra Pradesh, Arunachal Pradesh, Bihar, Chandigarh, Delhi, Goa, Gujrat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura
19	<i>Sarcophaga (Parasarcophaga) taenionota</i> (Wiedemann, 1819)	Sarcophaginae Townsend, 1917	Human and cow faeces along with dead animals	Assam	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar; Banhar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar

					Pradesh, West Bengal.
20	<i>Sarcophaga (Prionophalla) peregrina</i> (Robineau-Desvoidy, 1830)	Sarcophaginae Townsend, 1917	Breed in chicken manure	Assam	Bihar, Himachal Pradesh, Kerala, Maharashtra, Madhya Pradesh, Manipur, Mizoram, Nagaland, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Andaman and Nicobar Isl. Dadra and Nagar Haveli and Pondicherry
21	<i>Sarcophaga (Sarcorohdendorfia) antilope</i> (Bottcher, 1913)	Sarcophaginae Townsend, 1917	Internal parasites of lepidoptera insects	Margherita and Sadiya	Not recorded elsewhere in India.
22	<i>Sarcophaga (Sarcorohdendorfia) froggatti</i> (Taylor, 1917)	Sarcophaginae Townsend, 1917	Decayed carrion-baits	Assam	Not recorded elsewhere in India.
23	<i>Sarcophaga (Seniorwhitea) princeps</i> (Wiedemann, 1830)	Sarcophaginae Townsend, 1917	Feed and develop on vertebrates' carcasses	Assam	Arunachal Pradesh, Andhra Pradesh, Assam; several localities, Bihar; Chapra, Gujrat, Harayana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra; Mumbai, Manipur, Mizoram, Nagaland, Orissa; Barkuda isl., Pondicherry, Sikkim, Tamil Nadu; several localities, Tripura, Uttar Pradesh; Dehradun, West Bengal and Andaman.

Reference: Nandi, 2022, Chakraborty *et al.*, 2017, Chakraborty, 2019

Table 2. Species bionomics

Species	No.	%	Species in Table 1
Carrion, carcass, dead, meat baits	9	39.13	9, 10, 11, 12, 13, 14, 17, 22, 23
Bushes	3	13.04	5,7,8
Symbiotic relationships	2	8.69	1,2
Kleptoparasitic	3	13.04	3,4,6
Parasitoids	1	4.34	21
Faeces	5	21.73	15, 16, 18, 19, 20

No. = Number of Individuals; Species representation in Table 1: %= percentage to total

Senotainia navigatrix: This Miltogrammatinae fly is found in Silchar, Bihar, Kerala, Karnataka, and Tamil Nadu, breeding in the nests of Sphecidae and Apidae.

Several Sarcophaginae flies are reported from Assam, including *S. (Bercaea) africa*, *S. (Fengia) ostindicae*, *S. (Harpagophalla) kempi*, *S. (Iranihindia) futilis*, *S. (Iranihindia) indica*, *S. (Iranihindia) martellata*, *S. (Liopygia) ruficornis*, *S. (Liosarcophaga) brevicornis*, *S. (Liosarcophaga) dux*, *S. (Liosarcophaga) sarupi*, *S. (Liosarcophaga) scopariiformis*, *S. (Pandelleisca) assamensis*, *S. (Pandelleisca) bainbriggei*, *S. (Parasarcophaga) albiceps*, *S. (Parasarcophaga) misera*, *S. (Parasarcophaga) taenionota*, *S. (Prionophalla) peregrina*, *S. (Sarcorohdendorfia) antilope*, *S. (Sarcorohdendorfia) froggatti*, and *S. (Seniorwhitea) princeps*. These *Sarcophaga* flies have diverse bionomics, with some breeding in the nests of Hymenoptera, others feeding on decaying carrion, human/animal feces, and even causing

myiasis in dogs. Their distributions range across multiple states in India, with a few species like *S. (Sarcorohdendorfia) antilope* and *S. (Sarcorohdendorfia) froggatti* being restricted to Assam. Among the 23 there are four endemic (17.39%) and 19 (82.61%) non-endemic.

The results of the study provide a comprehensive taxonomic and ecological inventory of fly species found in the Assam region, highlighting their unique bionomics and distribution patterns within India.

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